Cermets

Stronger than steel, lighter than aluminum

Cermets are a class of composite materials composed of a ceramic and a metal. In the case of the B_4C-Al cermet developed at Lawrence Livermore National Laboratory for military armor, the ceramic is boron carbide (third hardest material known) and the metal is aluminum. This material was recognized by *R&D Magazine* as one of the 100 most valuable technologies for 1987. It is stronger for its weight than steel, lighter than aluminum, and can be five times more resistant to fracture than conventional structural ceramics. It may someday replace titanium and various steels, particularly where high strength-to-weight ratios and resistance to abrasion or impact are important.

The process is simple; properties can be tailored to the application

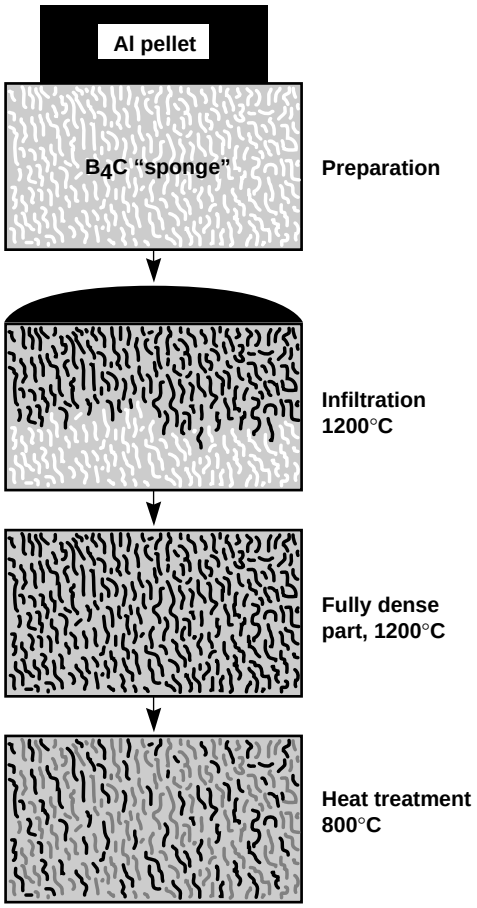
APPLICATIONS

- *Lightweight police body armor, armored trucks, limousines*
- *Low-inertia, dimensionally stable, and low-vibration rotating components for computer hard disk drives*
- *Long-life bearings, races, seals, and other wear parts*
- *Premium-performance sporting goods*
- *Cutting tools for hard-to-machine alloys*
- *Aircraft brake shoes (cermets would carry away frictional heat)*
- *Nuclear shielding (B_4C is an excellent neutron absorber)*

B_4C-Al cermet is produced by chemically washing boron-carbide powder to remove surface oxide or oil films. Then, the powder is packed into the intended shape with aluminum on top and heated to 1100°C. After the aluminum liquifies and is absorbed by the porous boron carbide, the temperature is reduced to about 800°C for heat treating.

The final product is so hard that machining, even by diamond tool grinding, must be avoided. Fortunately, because it is electrically conductive, it can be shaped with wire or electrode electrical discharge machining. Whenever possible, preforms are made by injection molding or slip casting to minimize final machining.

Specific material properties are determined by heat treating time (e.g., hardness needs long times; ductility and high tensile strength, shorter times.) Pure aluminum vs aluminum alloys and powder size of B_4C also affect cermet properties.



Steps in cermet preparation.

Availability: Four licenses have been granted for civilian and military applications. Nonexclusive or exclusive field-of-use licenses will be tailored to meet the needs of interested companies.

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